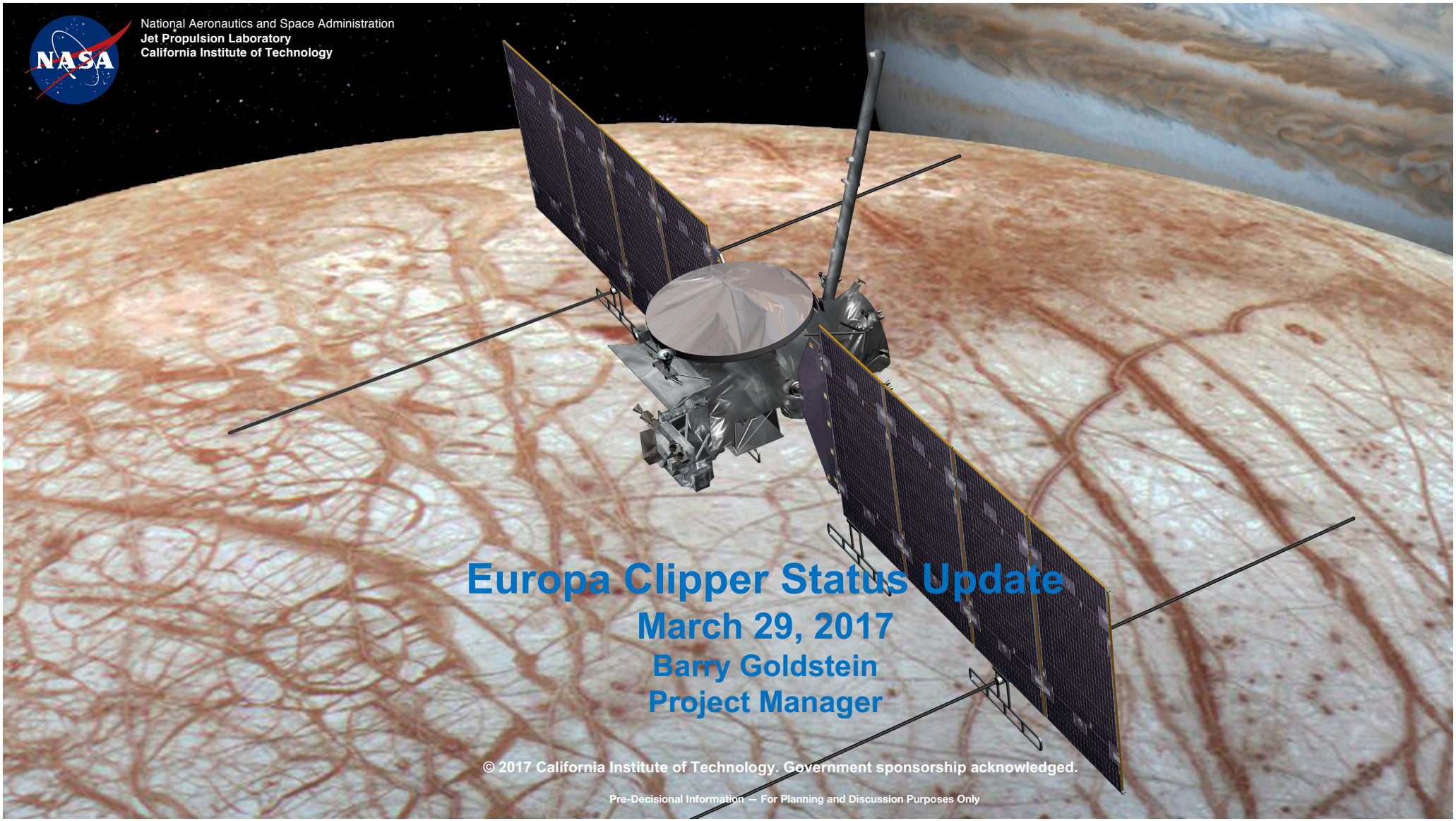

National Aeronautics and Space Administration
Jet Propulsion Laboratory
California Institute of Technology
Europa Clipper Status Update
March 29, 2017
Barry Goldstein
Project Manager
© 2017 California Institute of Technology. Government sponsorship acknowledged.
Pre-Decisional Information — For Planning and Discussion Purposes Only

Significant Developments

- Conducted successful Mission Definition Review / Systems Requirements review (MDR/SRR)
- Project has progressed to Phase-B
- Official Project Name is "**Europa Clipper**"
- Mission launch vehicle assumed SLS
  - No longer required to be compatible with EELV

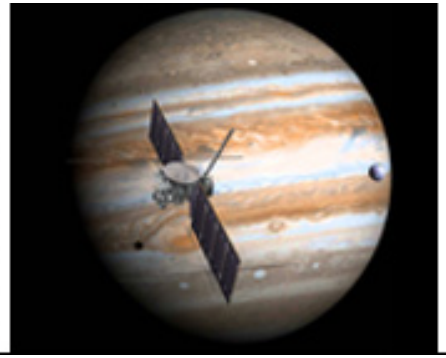
Mission Overview

Earliest Launch

*Period: 6/4/22 – 6/24/22 (SLS)
*Period: 6/18/22 – 7/8/22 (EELV)

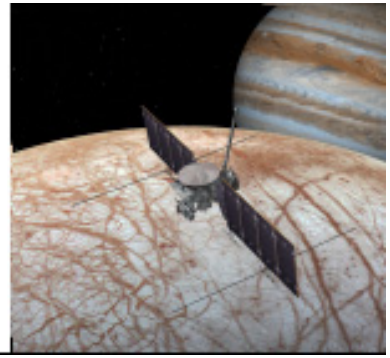
Cruise:

2.5 Years (SLS)
7.4 Years (EELV)



Jupiter Orbit Insertion

12/24/24 or 5/1/25 (SLS)
11/26/29 (EELV)



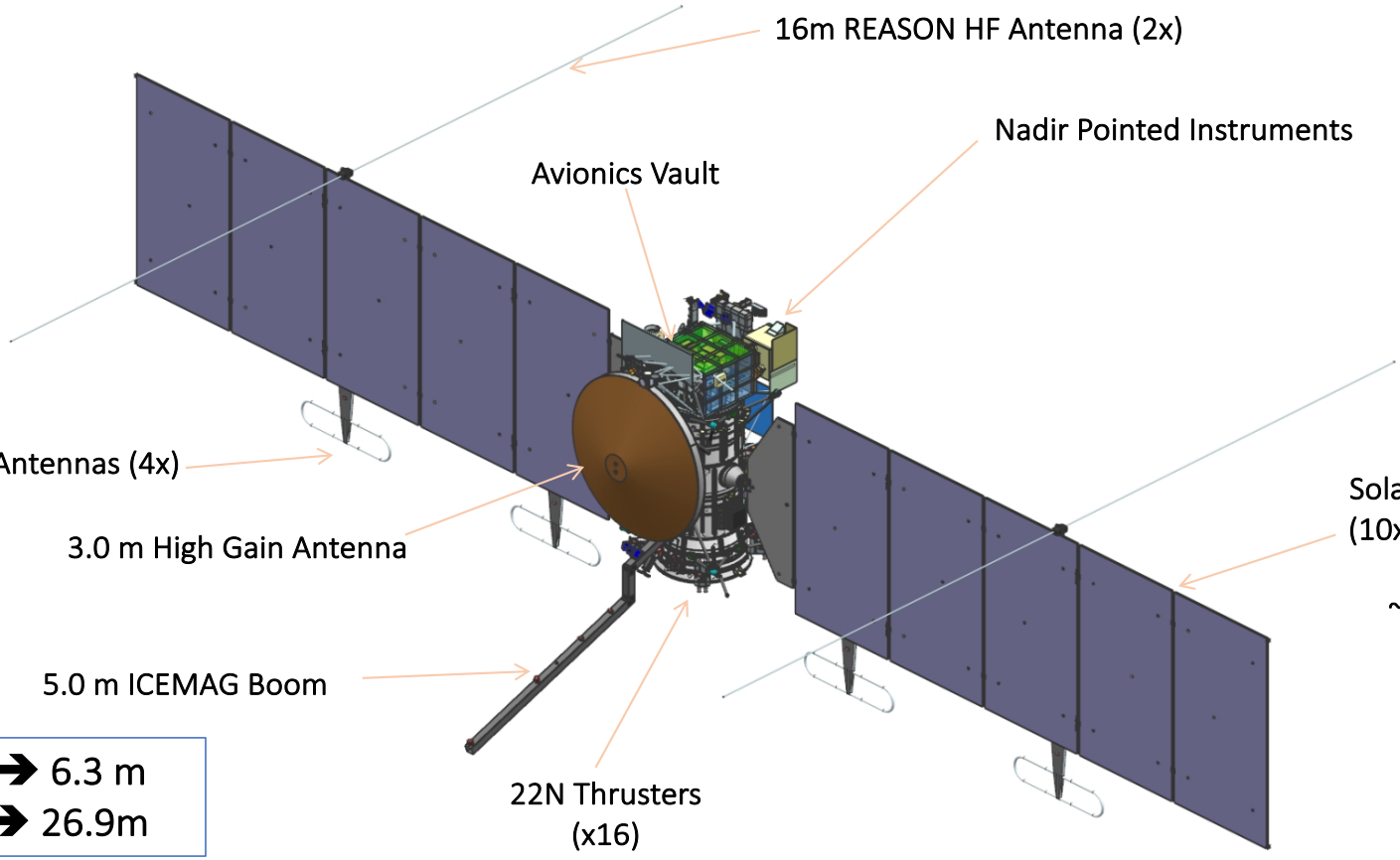
Jovian System Operations

Transition to Europa Science: 12 months
Prime Europa Flyby Campaign: 36 months

*** - Dependent on Funding**

- **Project Category 1**
  - LCC > $1B
- **Mission Risk Class A (With tailoring)**
- **NPR 7120.5E Compliant (No waivers)**
- **S/C design compatible with both SLS and EELV**

Current Clipper Spacecraft Concept



S/C Height ➔ 6.3 m
S/C Width ➔ 26.9m

Significant Hardware Development Progress

Engineering Model Telecommunications Radio

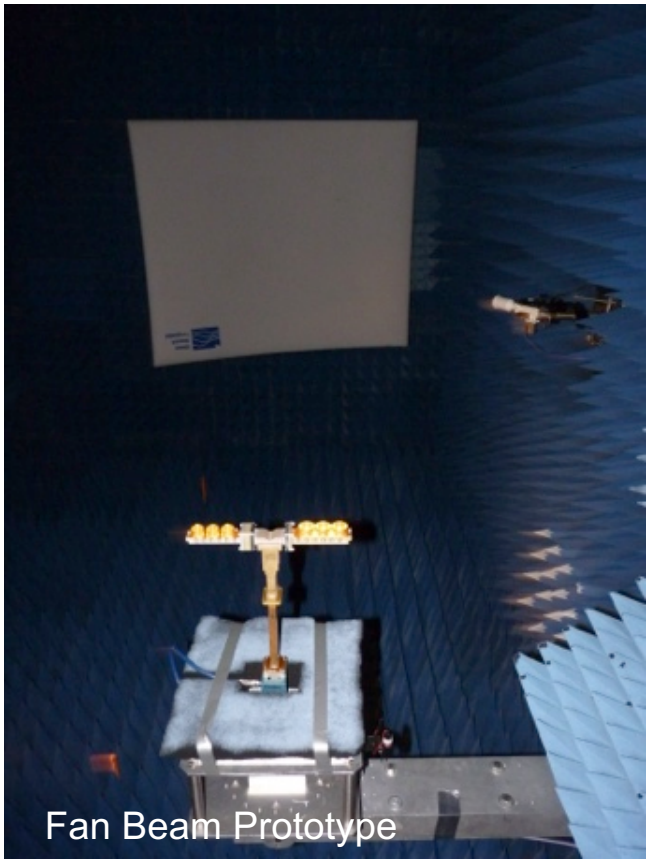
Significant Hardware Development Progress

3 Meter Diameter High Gain Antenna Prototype

Significant Hardware Development Progress

Antenna Pattern and Gain Testing At Langley Research Center


HGA Prototype


Fan Beam Prototype

Significant Hardware Development Progress

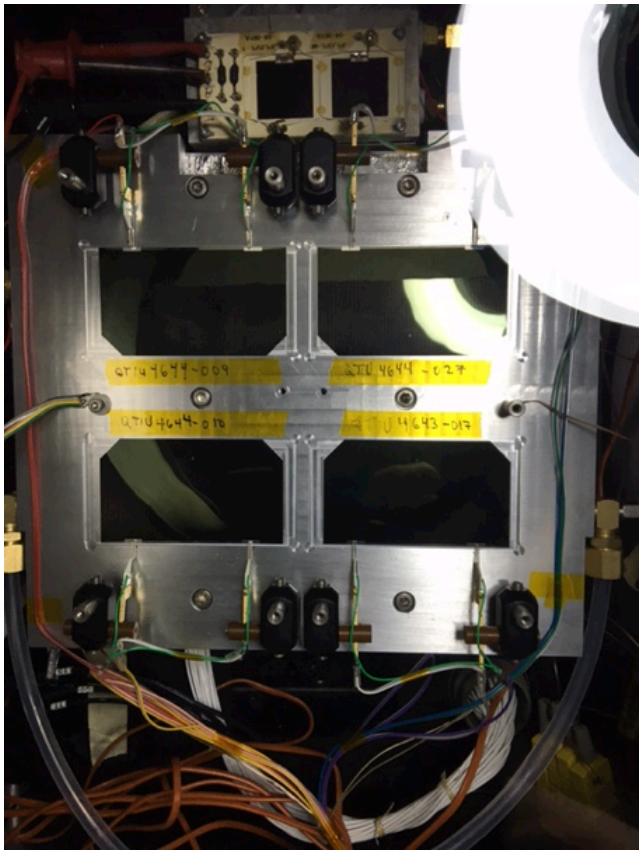
Battery Cell & Module Testing

Battery configurations being optimized

210 total Cells (~AA)

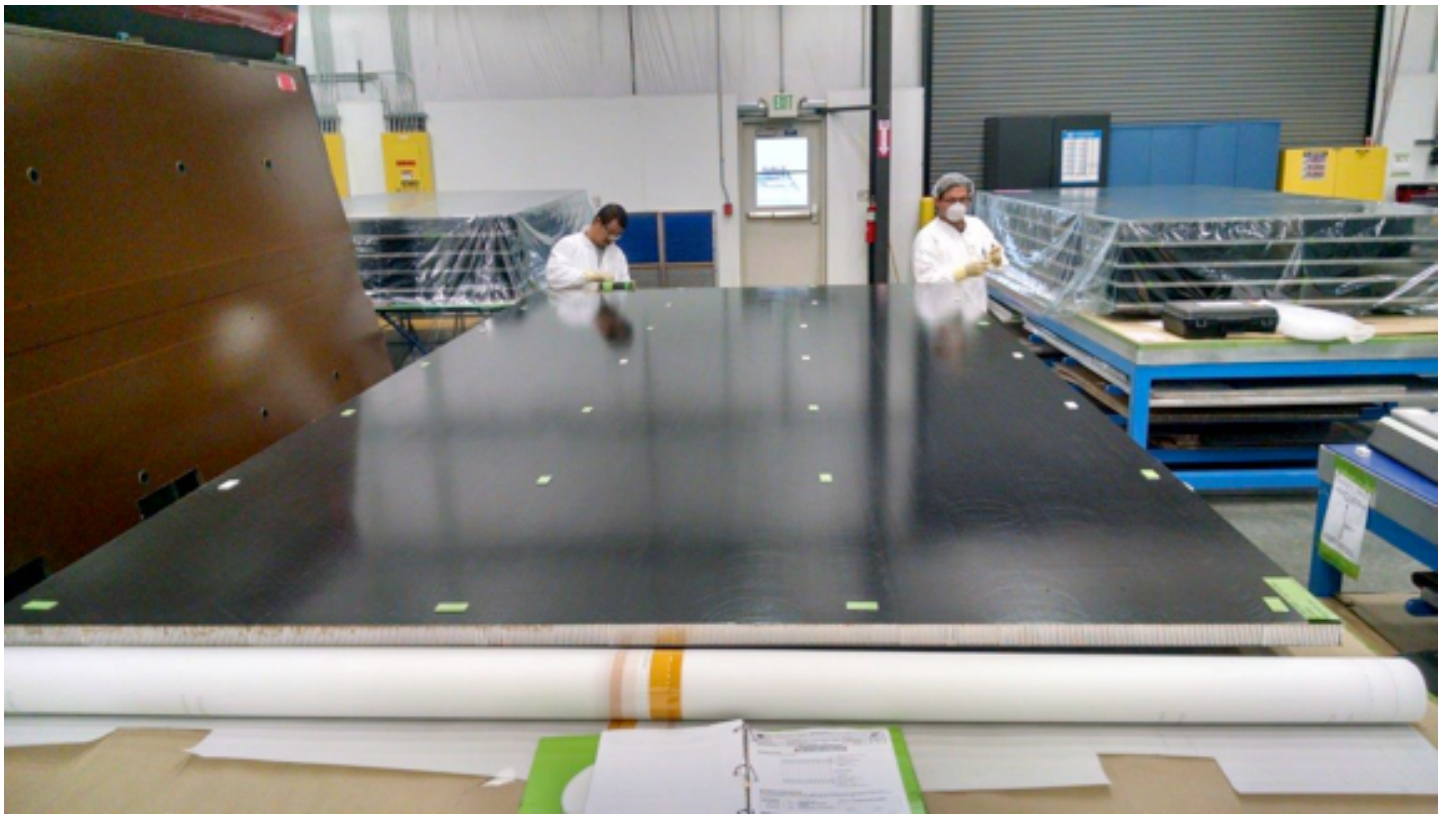
Significant Hardware Development Progress

Solar Cells in
radiation test fixture



Solar Cell Low Intensity / Low Temperature & Radiation Testing

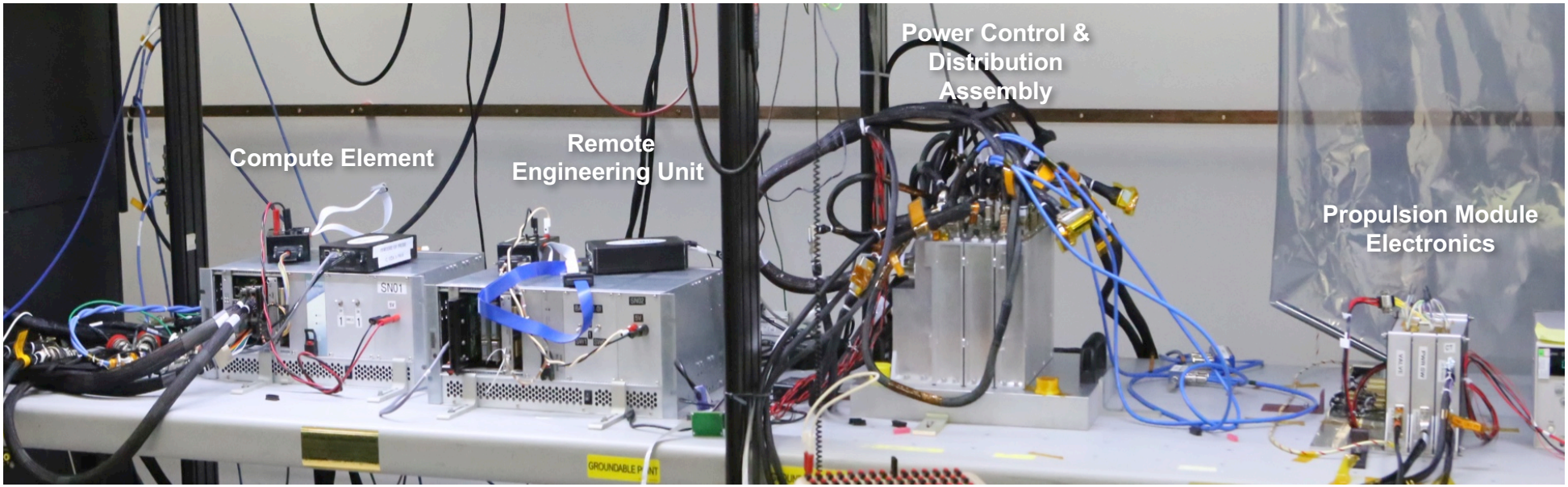
Significant Hardware Development Progress



Full Size Solar Array Panel Demonstrator (2.2m x 4.1m)

One of Ten!

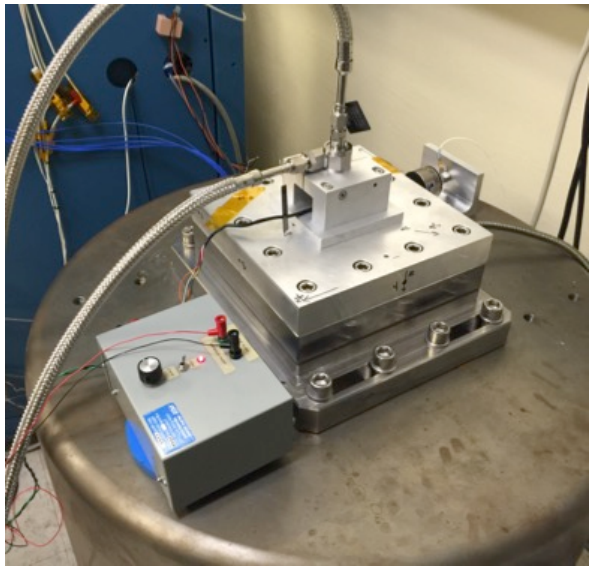
Significant Hardware Development Progress



Prototype Avionics Testbed

(Running Time/Space Partitioned Flight Software)

Significant Hardware Development Progress

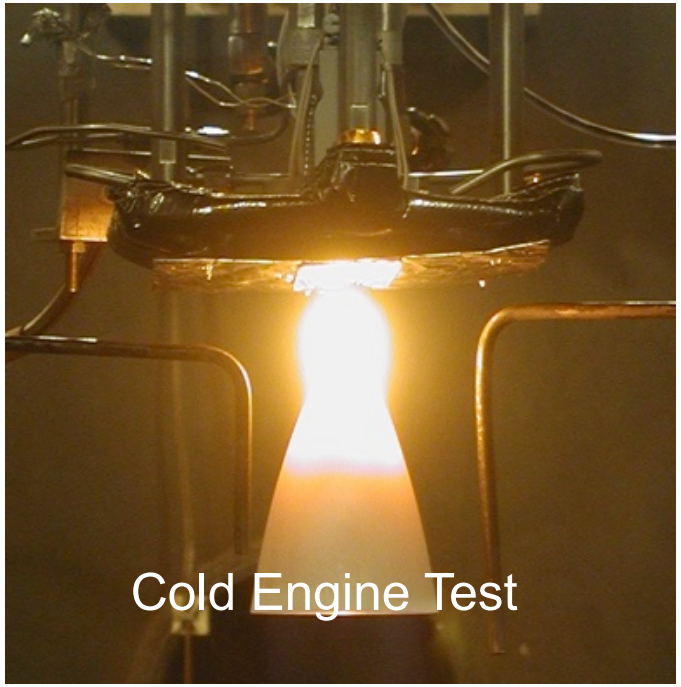


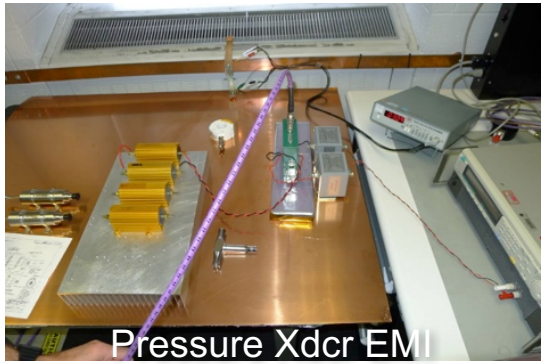
Thermal Pump Microphonics Test

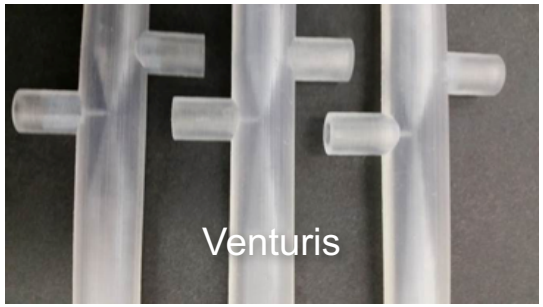
Thermal Pump Life Test (Irradiated CFC-11)

CFC-11 Lifetime Buy

Significant Hardware Development Progress





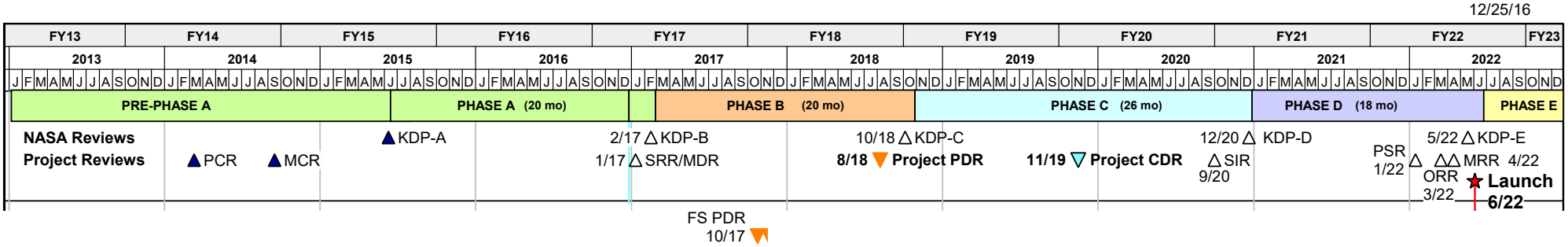


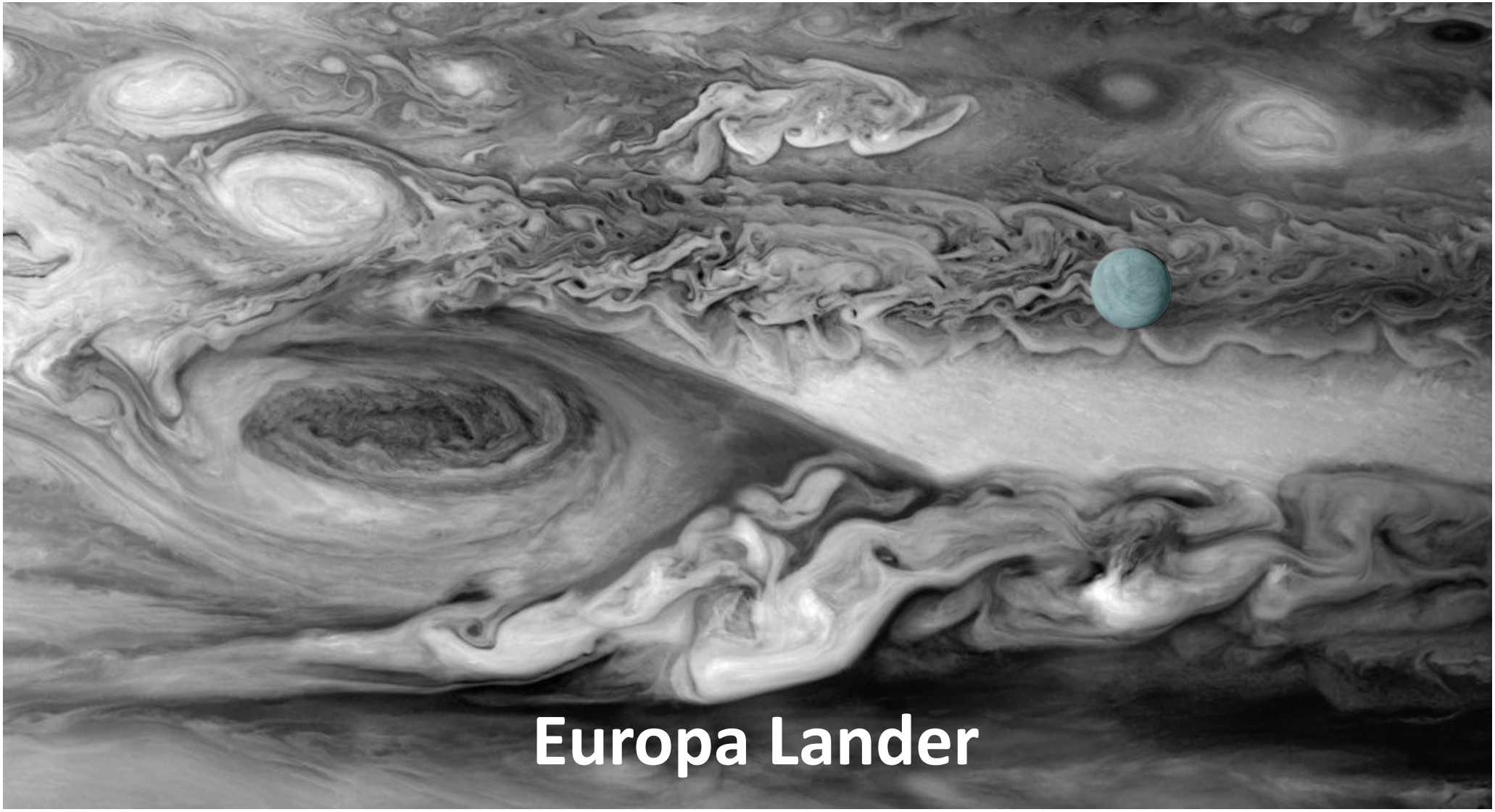
Propulsion Component Tests

Project-Level Lifecycle Schedule

Key Project Reviews

Europa Multi-Flyby Mission (SLS)



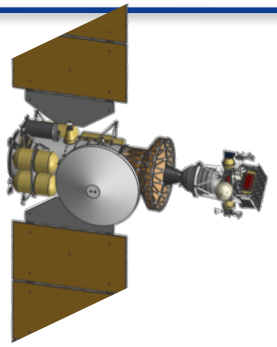


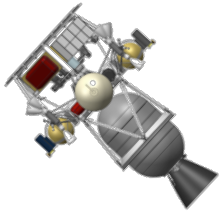
Europa Lander

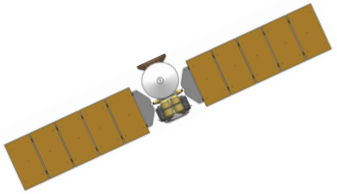
Mission Concept Update

3/29/2017

Viable Lander/Carrier Mission Concept





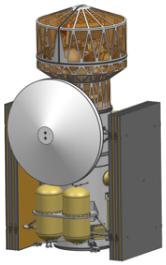


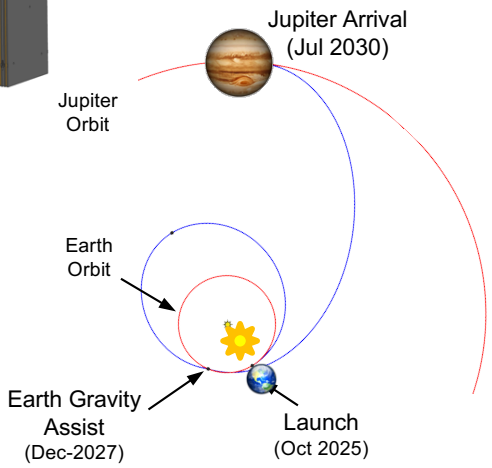
Carrier Relay Orbit

- 24 hour period
- >10 hours continuous coverage per orbit
- 2 Mrad radiation exposure

Cruise/Jovian Tour

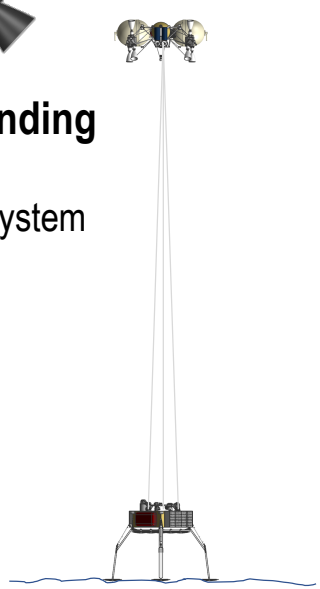
- Jupiter orbit insertion Jul 2030
- Earliest landing on Europa: Dec 2031





Deorbit, Decent, Landing

- Guided deorbit burn
- Sky Crane landing system
- 100m accuracy

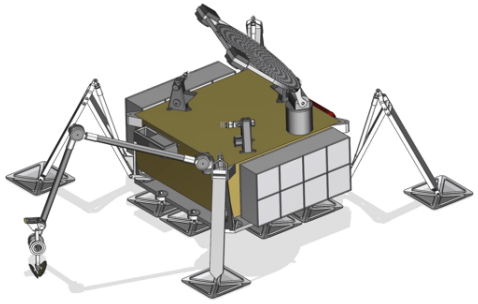


Launch

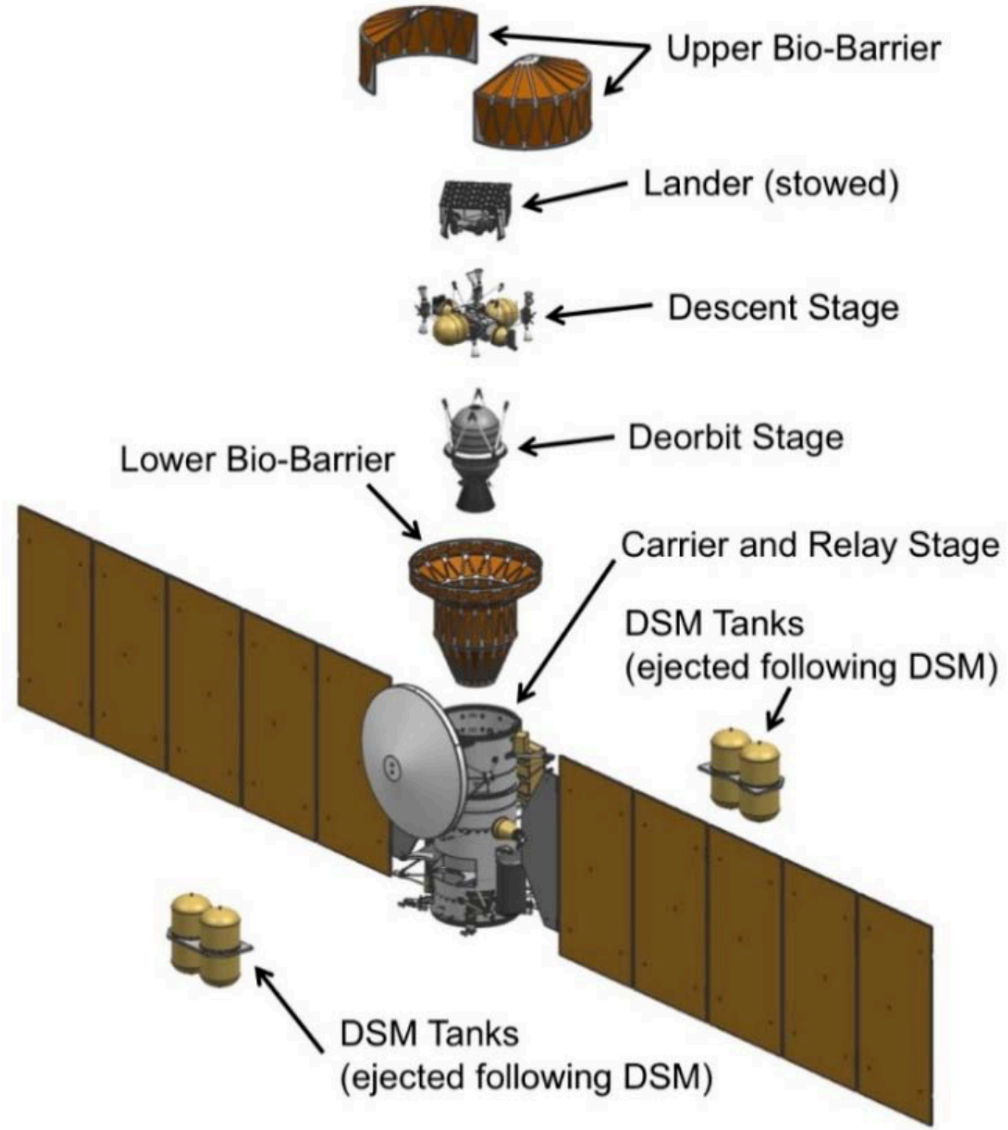
- SLS Block 1B
- Oct / Dec 2025

Surface Mission

- 20+ days
- 5 Samples
- Relay comm through Carrier or Clipper (backup)
- 3-4 Gbit data return
- 45 kWh battery
- 1.5 Mrad radiation exposure



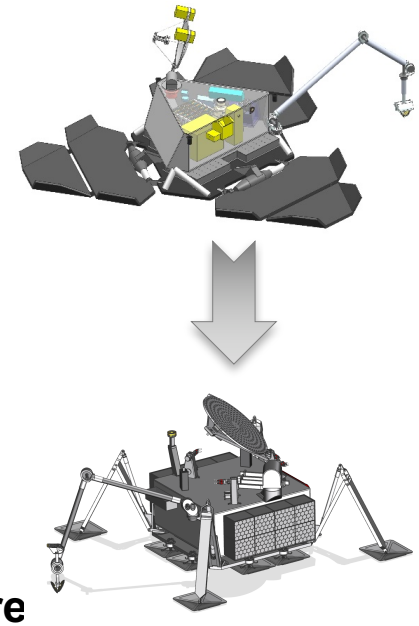
Europa Lander Integrated Spacecraft Concept



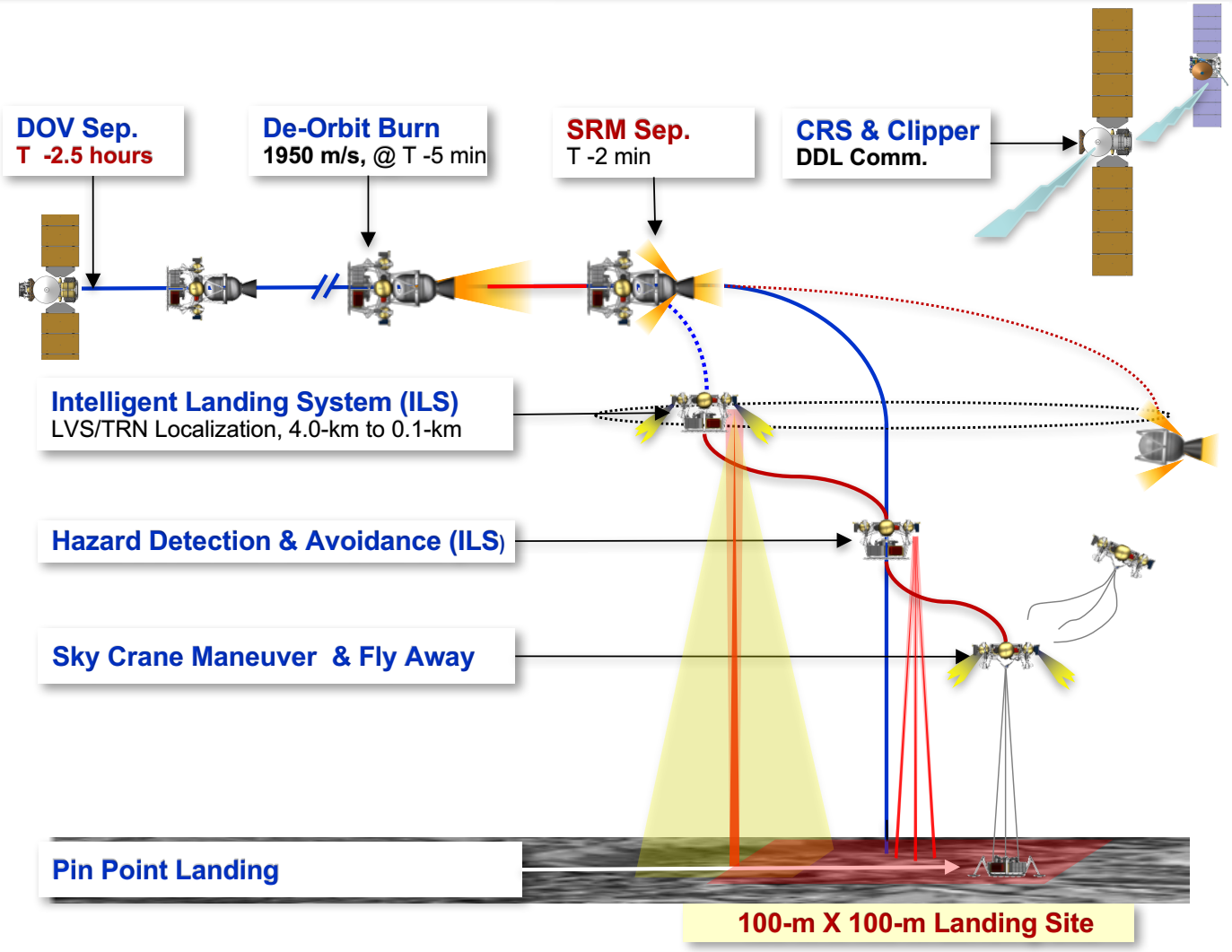
Preliminary
Launch Mass (Wet):
CRS: ~14 mT
Deorbit stage: 1.6 mT
DS + Lander: 1.1 mT
Total: ~16.6 mT

Highlights of Lander Development Concept Progress

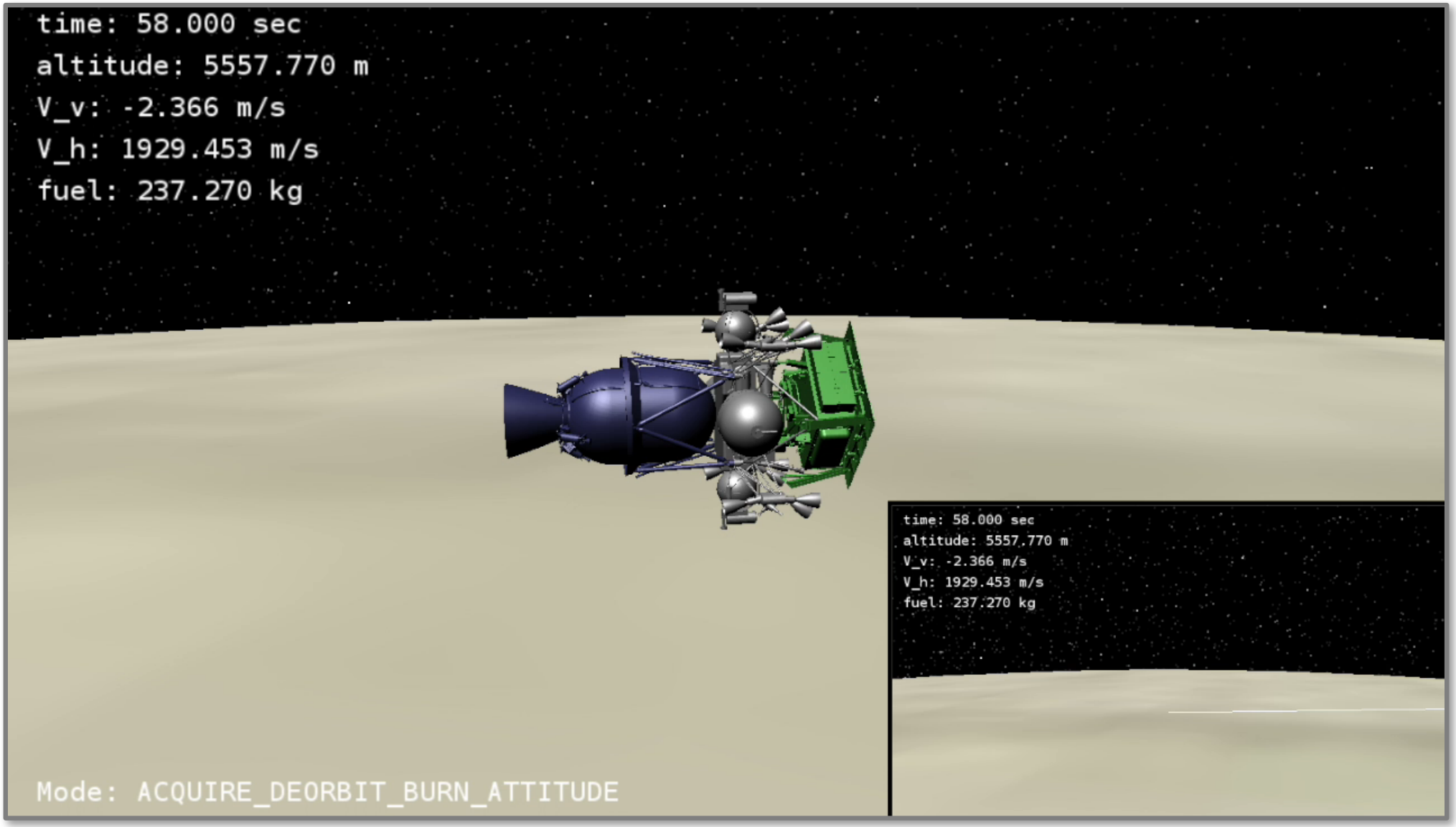
1. **Selected the adaptive stabilizer landing gear**
   - ✓ **Resilient to >1.0 meter obstacles**
2. **Accommodated SDT Sample Payload**
   - ✓ **5 Instruments at 42.5 kg**
3. **Accommodated redundant electronics**
   - ✓ **Avionics, Power Distribution and Telecom**
4. **Developed the Lander Planetary Protection Architecture**
   - ✓ **Added the incinerator and hydrogen peroxide purge**
5. **Added Rasp/Scoop in conjunction with the Saw**
   - ✓ **Phoenix heritage for reliable sample acquisition**



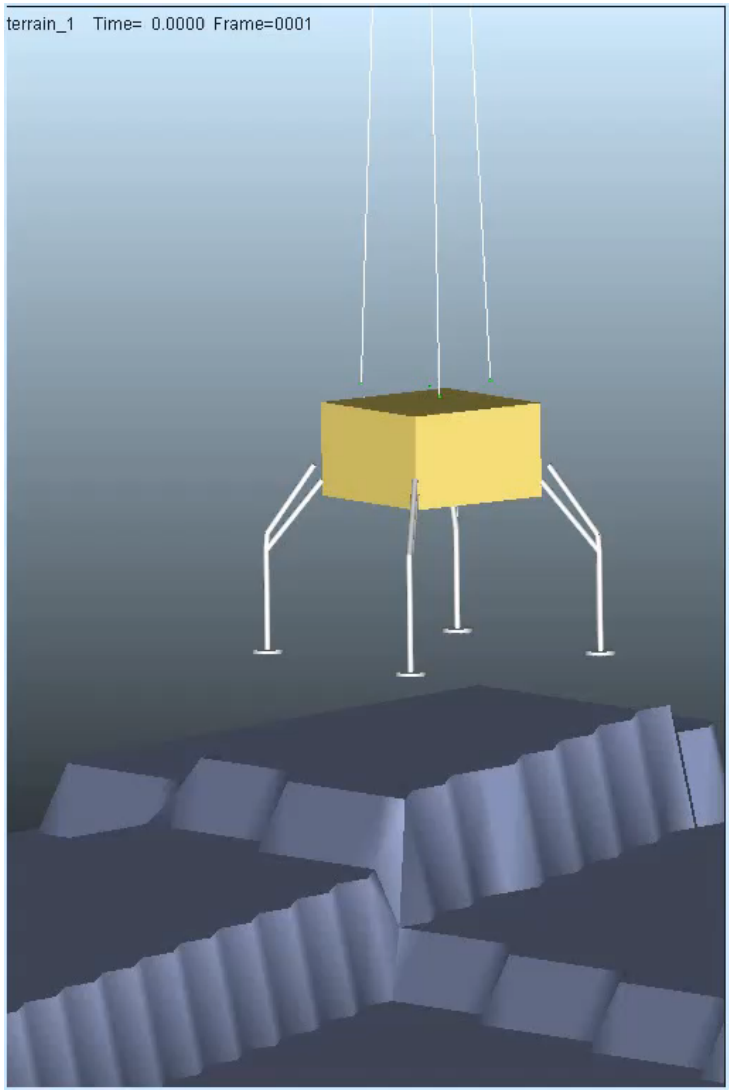
De-Orbit, Descent & Landing (DDL) Concept



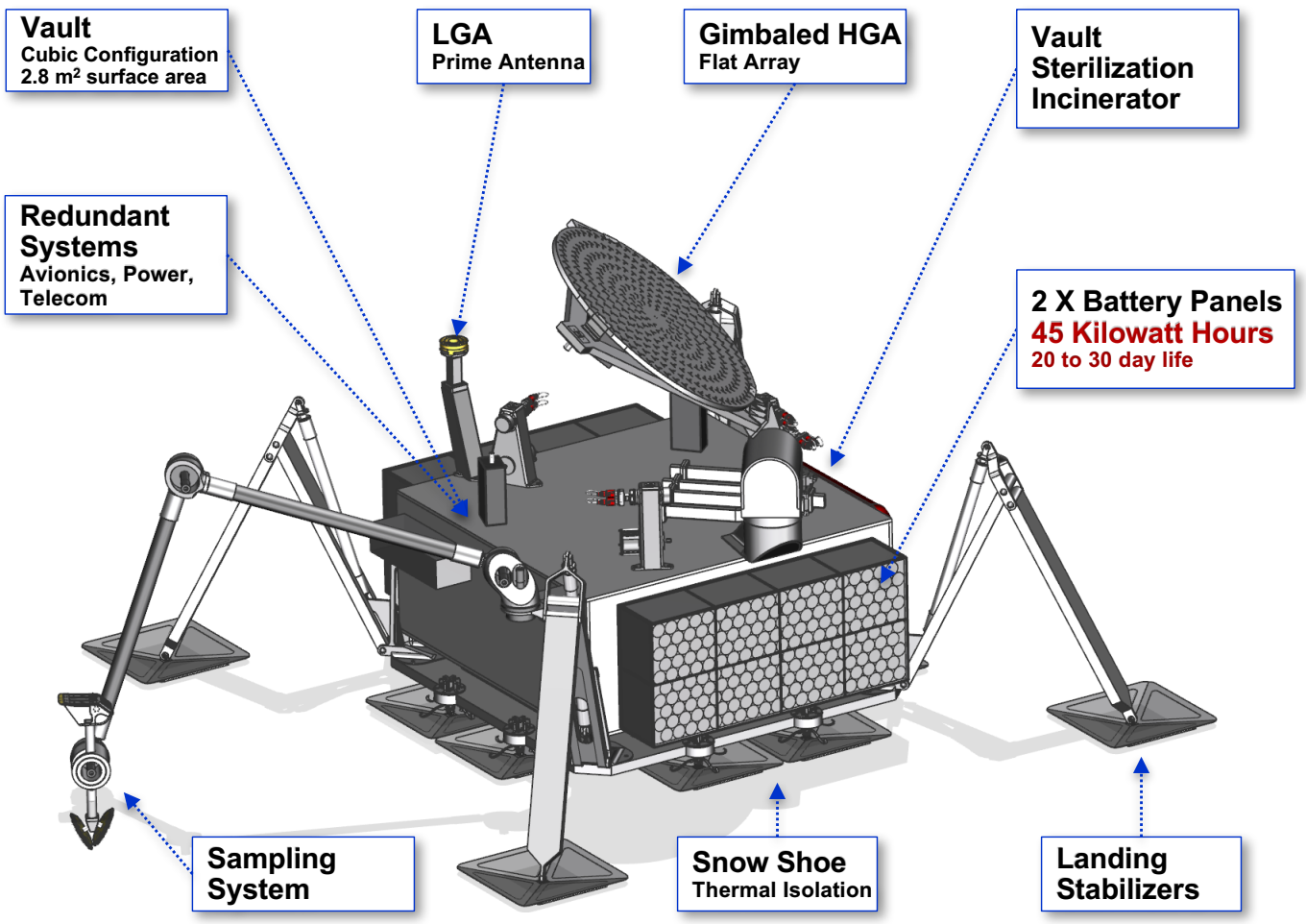
Initial 6-DoF GN&C Video of De-Orbit, Descent and Landing



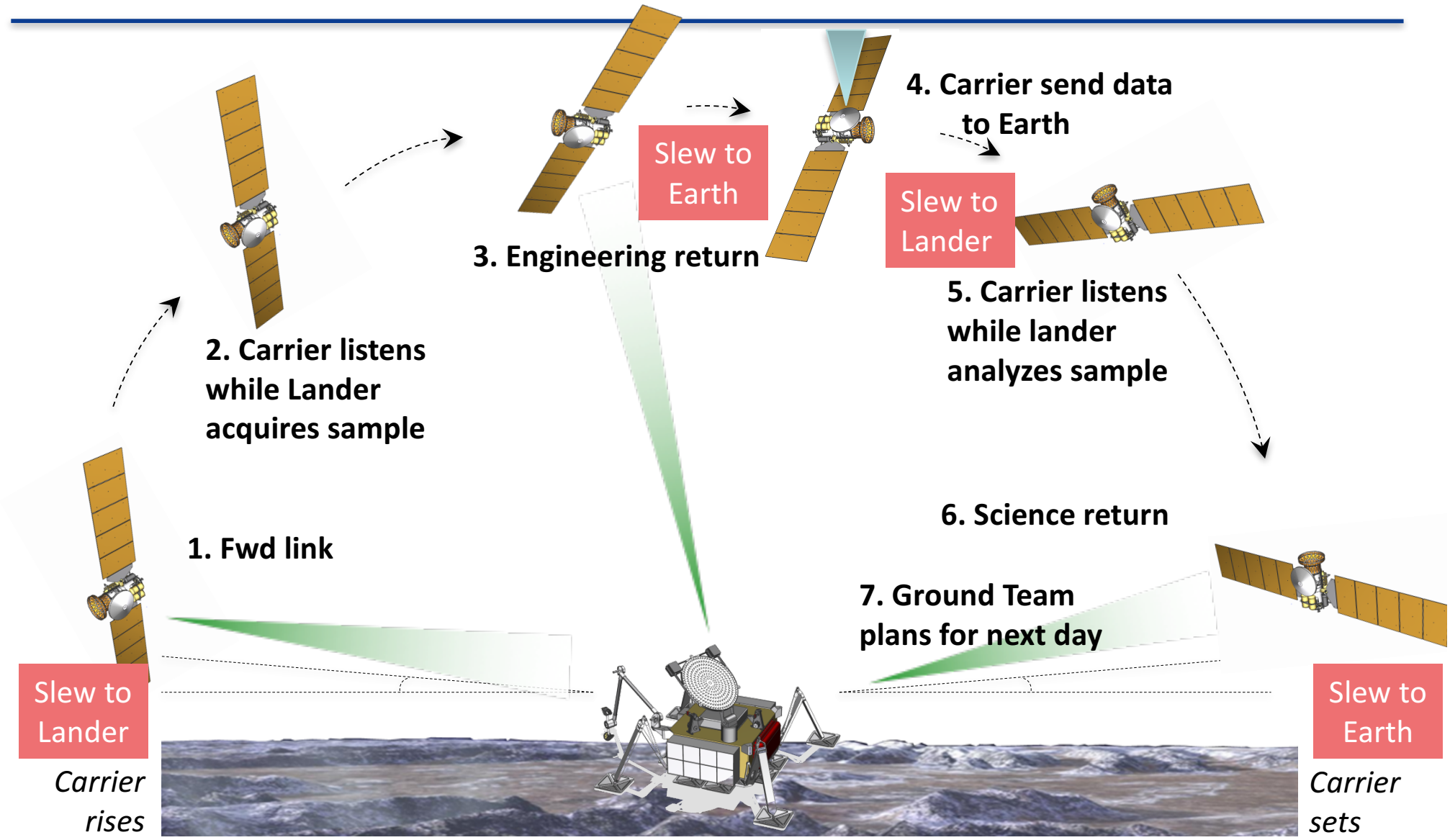
Adaptive Stabilizer Landing Simulation Succeeds in Very Challenging Terrain



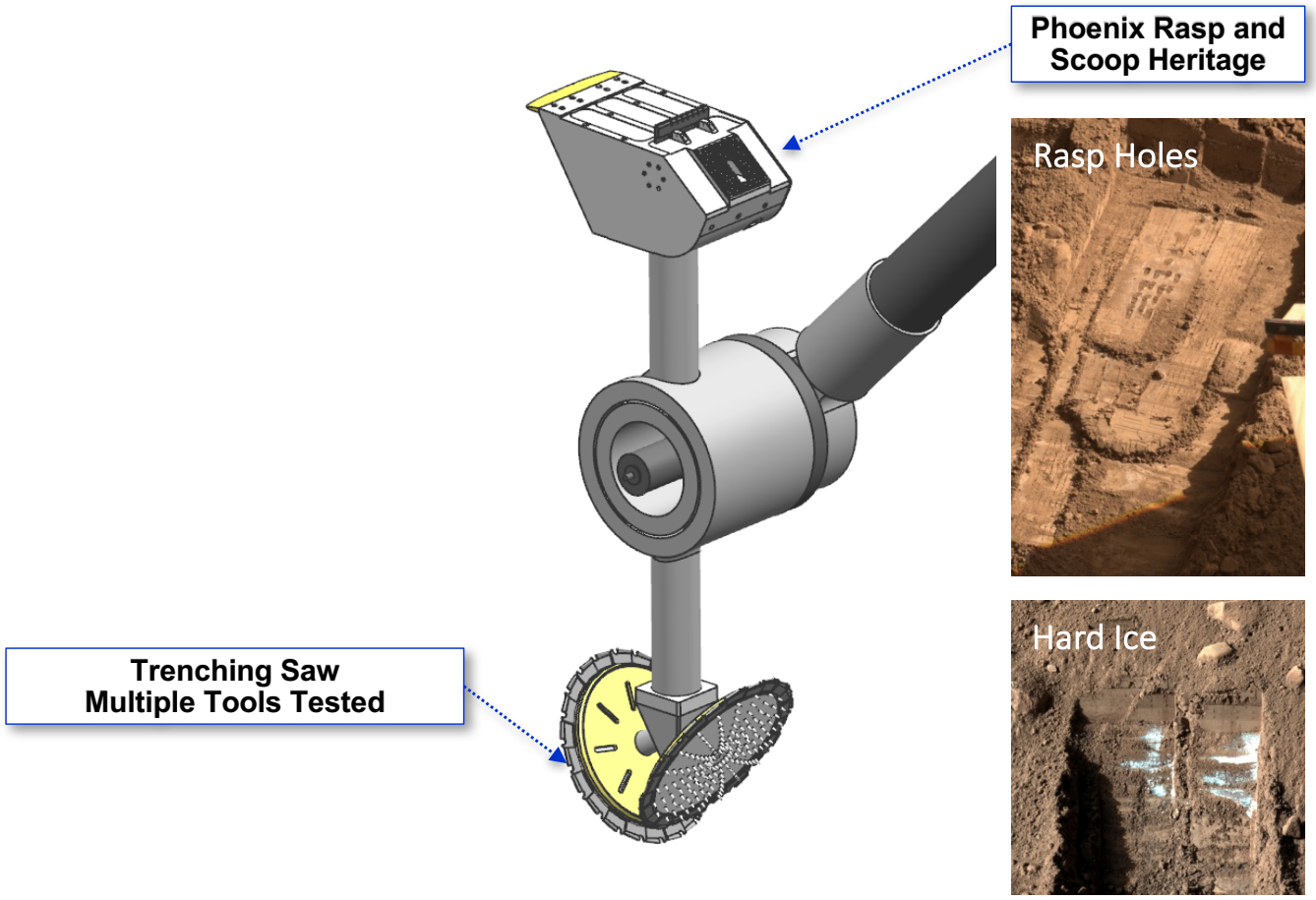
Concept Lander Surface Configuration



A Day in the Life of Concept Lander
Relay Operations



The Phoenix Heritage Rasp and Scoop was Added for Robust Sample Collection

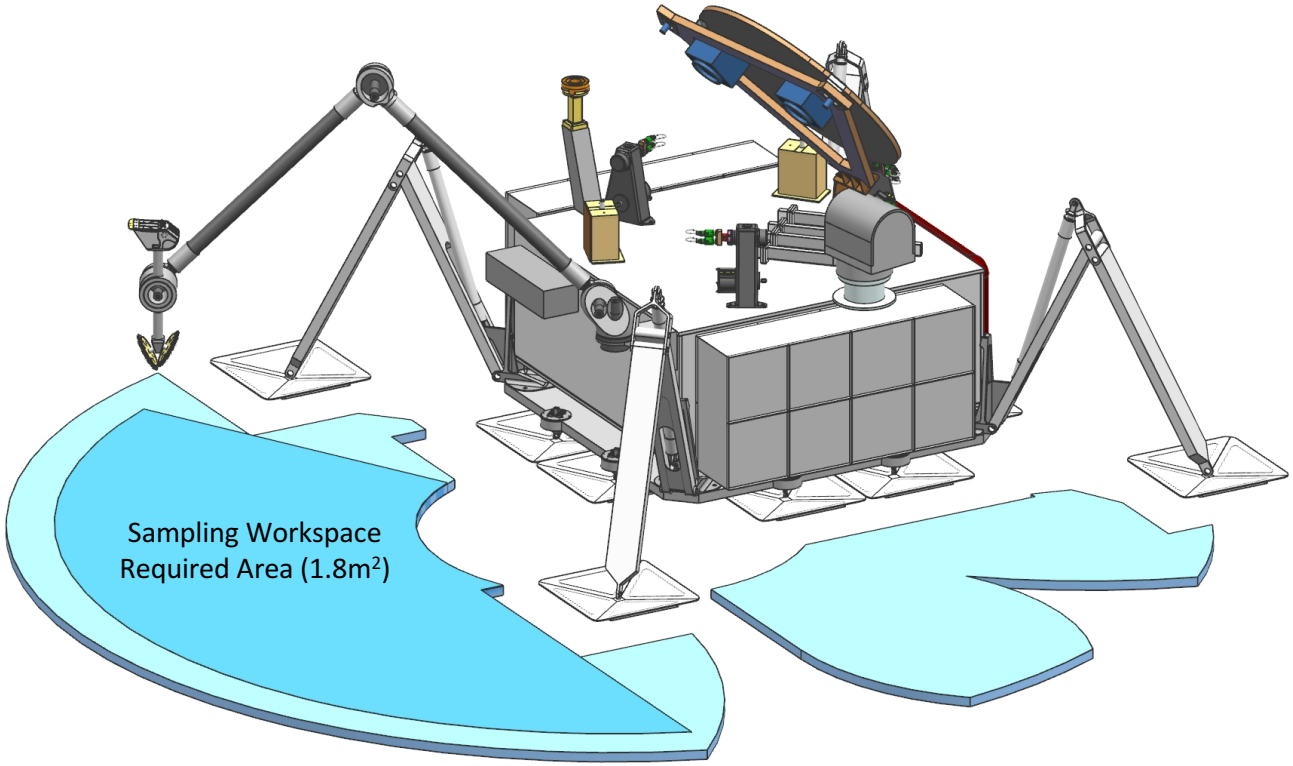


Trenching Saw Had Successful Proof of Concept Tests in a Dedicated Testbed

Test Progress

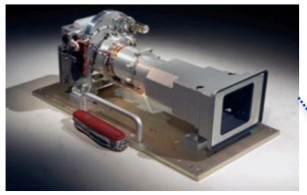
- 35 different blade types
- 25 different materials including cryogenic Ices
- Two different drive trains with a third one in work

Surfaces Workspace Exceeds the Required Area & Can Access Two Sides of Lander

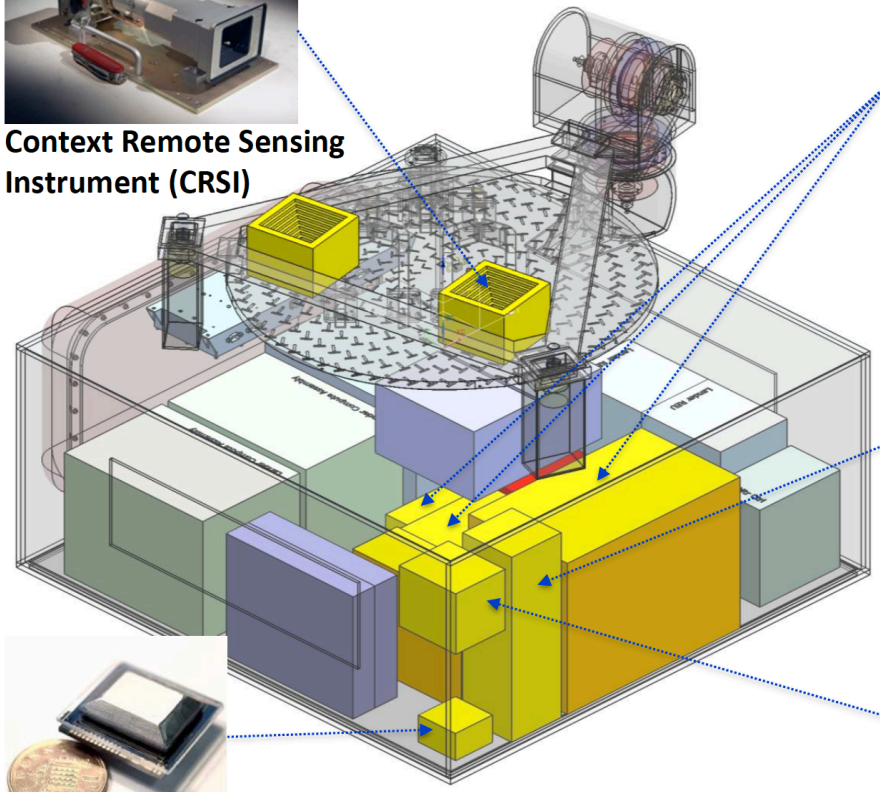


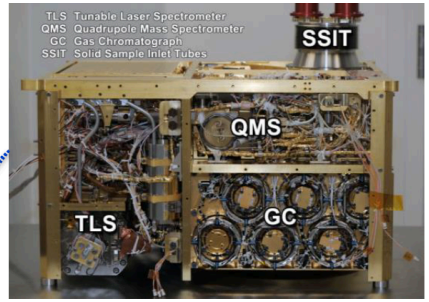
Backup

Mission Concept closes, with margin

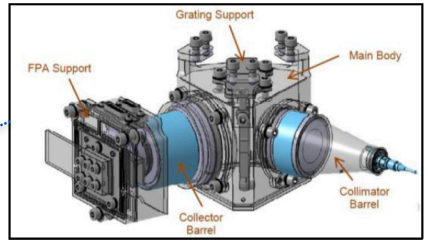


Context Remote Sensing Instrument (CRSI)

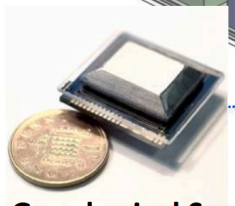




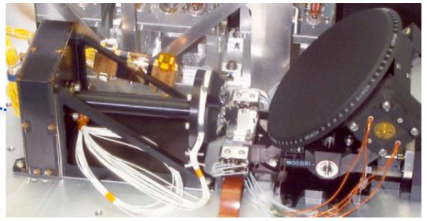
Organic Compositional Analyzer (OCA)



Vibrational Spectrometer (VS)

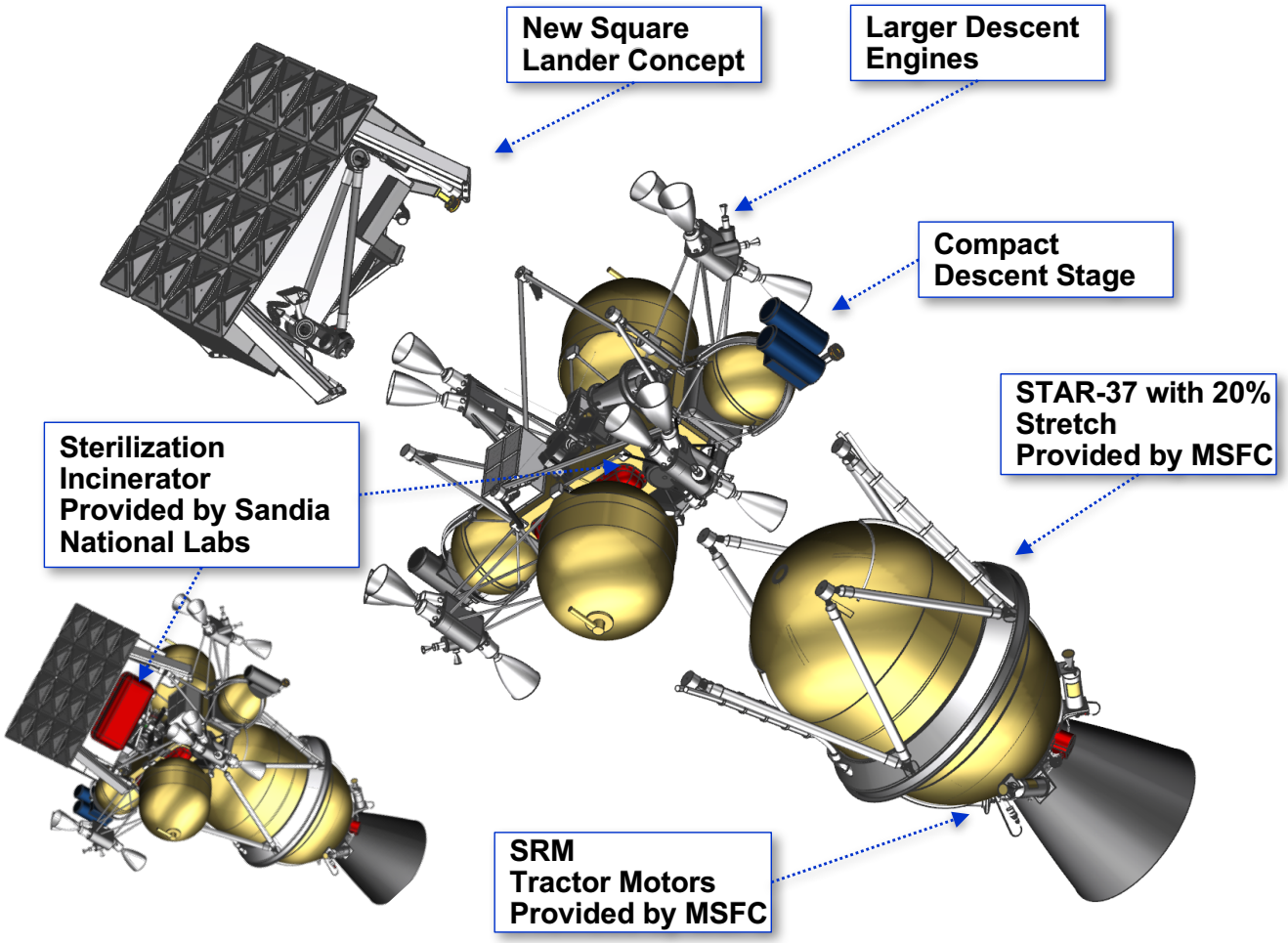


Geophysical Sounding System (GSS)



Microscope for Life Detection (MLD)

Iteration-4.0 Configuration is the Culmination of Extensive Trade Studies



Lander Accommodates Model Instrument Payload and Supporting Equipment